

9.0 FACILITY RADIATION SURVEYS

PURPOSE OF THIS SECTION

The purpose of this section is to describe radiation surveys to be performed in connection with Phase 1 of the WVDP proposed decommissioning.

INFORMATION IN THIS SECTION

This section first refers to the cleanup criteria for surface soil, subsurface soil, and streambed sediment that would be used to ensure that the level of remediation achieved during Phase 1 would not limit options for Phase 2 of the decommissioning. It then identifies the types of radiological surveys to be performed and the purpose of each survey. Requirements for background surveys, characterization surveys, in-process surveys, and the Phase 1 final status surveys are described.

This section outlines the survey process for each waste management area and then for environmental media. It concludes with a summary of requirements for the Phase 1 Status Survey Report.

While this section addresses all applicable requirements for facility radiation surveys, it does so in general terms because two supplemental documents would later be developed to provide additional details: a Characterization Sample and Analysis Plan and a Phase 1 Final Status Survey Plan (or multiple Phase 1 Final Status Survey Plans).

RELATIONSHIP TO OTHER PLAN SECTIONS

To put into perspective the information in this section, one must consider:

- The information in Section 1 on the project background and those facilities and areas within the scope of the DP;
- The information in Section 2 on facilities to be removed before the Phase 1 proposed decommissioning activities begin;
- The facility descriptions in Section 3;
- The information on the results of scoping and characterization surveys contained in Section 4 and Appendix B;
- The information in Section 5 on dose modeling and cleanup criteria; and
- The proposed decommissioning activities and related characterization activities described in Section 7.

The proposed characterization survey process described in this section applies to characterization surveys performed in connection with proposed decommissioning activities described in Section 7.

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The survey methodology specified in this section is consistent with the provisions of NUREG-1757, Volume 2 (NRC 2006) and with the guidance found in NUREG-1575, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (NRC 2000). It is also consistent with DOE requirements of DOE Order 5400.5, *Radiation Protection of the Public and the Environment*.

As used in this section, the term *surveys* includes both systematic scanning and static measurements performed with an appropriately-sensitive instrument calibrated to the radiation of interest, as well as the laboratory analysis of physical samples of potentially contaminated media.

9.1 Release Criteria

Release criteria are based on the dose modeling described in Section 5 and the planned end-states for facilities and areas within the scope of the plan as discussed in Sections 1 and 7. The appearance of the Phase 1 end-state for the project premises would be similar to that shown in Figure 1-5. As explained in Section 5, derived concentration guideline levels (DCGLs) were developed for surface soil, subsurface soil and streambed sediment.

Note that DCGLs for the WVDP Phase 1 proposed decommissioning end state are expressed on the basis of 25 mrem total effective dose equivalent annually to the average member of the critical group. This annual dose is used as the basis for the cleanup criteria because the resulting DCGLs provide a conservative end state that ensures that all decommissioning options for the remainder of the project premises and the Center remain available in Phase 2.

DCGLs and Cleanup Goals

Because of the complexity of the site and the necessity to ensure that the Phase 1 proposed cleanup activities would support a range of approaches that might be used for Phase 2 of the decommissioning, cleanup goals lower than the DCGLs would be used as indicated in Section 7. These goals are identified in Table 5-14 of Section 5. The cleanup goals are referred to in this section simply as the DCGLs for consistency in terminology.

The $DCGL_W$ is the release criterion based on average concentration of radioactivity distributed over a large area. Area factors are used to adjust the $DCGL_W$ values to estimate the $DCGL_{EMC}$, the criterion for small areas of contamination elevated above the release criterion and to estimate the minimum detectable concentration for scanning surveys.

The $DCGL_W$ and $DCGL_{EMC}$ values (i.e., the cleanup goals) for 18 radionuclides of interest are expressed in Table 5-14 in Section 5. Tables 9-1, 9-2, and 9-2 provide ranges of area factors.

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Table 9-1 Surface Soil Cleanup Goal Area Factors⁽¹⁾

Nuclide	DCGL _w 10,000 m ² (pCi/g)	Area Factors (DCGL _{EMC} /DCGL _w)							
		5,000 m ²	1,000 m ²	500 m ²	100 m ²	50 m ²	10 m ²	5 m ²	1 m ²
Am-241	4.9E+01	1.0E+00	1.0E+00	1.9E+00	7.2E+00	1.1E+01	2.6E+01	3.8E+01	8.07E+01
C-14	3.1E+01	1.7E+00	4.3E+00	1.2E+01	1.2E+02	3.3E+02	2.9E+03	6.1E+03	3.06E+04
Cm-243	4.2E+01	1.0E+00	1.0E+00	1.4E+00	2.3E+00	2.6E+00	4.2E+00	6.3E+00	1.80E+01
Cm-244	9.4E+01	1.0E+00	1.0E+00	2.0E+00	9.2E+00	1.7E+01	5.4E+01	7.7E+01	1.31E+02
Cs-137	2.7E+01	1.1E+00	1.1E+00	1.2E+00	1.5E+00	1.6E+00	2.5E+00	3.8E+00	1.14E+01
I-129	5.8E-01	1.8E+00	1.0E+01	2.3E+01	1.3E+02	2.5E+02	1.3E+03	2.5E+03	1.27E+04
Np-237	9.6E-02	1.6E+00	8.1E+00	1.8E+01	9.8E+01	2.0E+02	9.7E+02	1.9E+03	9.31E+03
Pu-238	5.8E+01	1.0E+00	1.0E+00	2.0E+00	9.3E+00	1.7E+01	5.5E+01	7.9E+01	1.32E+02
Pu-239	5.2E+01	1.0E+00	1.0E+00	2.0E+00	9.3E+00	1.7E+01	5.5E+01	7.9E+01	1.34E+02
Pu-240	5.2E+01	1.0E+00	1.0E+00	2.0E+00	9.3E+00	1.7E+01	5.5E+01	7.9E+01	1.34E+02
Pu-241	1.6E+03	1.0E+00	1.0E+00	1.9E+00	7.4E+00	1.2E+01	2.7E+01	3.9E+01	8.25E+01
Sr-90	8.7E+00	1.7E+00	3.2E+00	6.5E+00	3.2E+01	6.3E+01	2.9E+02	5.7E+02	2.64E+03
Tc-99	2.9E+01	1.0E+00	1.0E+00	2.1E+00	1.0E+01	2.1E+01	1.0E+02	2.0E+02	1.02E+03
U-232	5.6E+00	1.6E+00	7.7E+00	1.6E+01	3.3E+01	3.6E+01	5.8E+01	8.7E+01	2.68E+02
U-233	2.0E+01	1.6E+00	8.3E+00	1.8E+01	9.9E+01	2.0E+02	9.8E+02	1.9E+03	8.87E+03
U-234	2.1E+01	1.6E+00	8.3E+00	1.8E+01	1.0E+02	2.0E+02	1.0E+03	2.0E+03	9.41E+03
U-235	1.4E+01	1.6E+00	8.1E+00	1.7E+01	7.8E+01	9.7E+01	1.5E+02	2.2E+02	6.53E+02
U-238	2.2E+01	1.6E+00	8.2E+00	1.8E+01	9.5E+01	1.8E+02	7.5E+02	1.1E+03	3.18E+03

NOTE: (1) From Table C-16 of Appendix C. The values in the second column are the cleanup goals (CG_w) from Table 5-14.

Table 9.2. Subsurface Soil Cleanup Goal Area Factors⁽¹⁾

Nuclide	DCGL _w 100 m ² (pCi/g)	Area Factors (DCGL _{EMC} /DCGL _w)			
		50 m ²	10 m ²	5 m ²	1 m ²
Am-241	2.9E+03	1.4E+00	2.6E+00	3.6E+00	7.1E+00
C-14	1.9E+05	2.0E+00	9.8E+00	1.8E+01	9.1E+01
Cm-243	5.1E+02	1.1E+00	1.8E+00	2.7E+00	7.9E+00
Cm-244	8.8E+03	1.7E+00	4.1E+00	5.3E+00	7.5E+00
Cs-137	2.0E+02	1.1E+00	1.8E+00	2.7E+00	8.5E+00
I-129	1.9E+02	2.0E+00	9.5E+00	1.9E+01	9.3E+01
Np-237	1.7E+01	1.9E+00	9.3E+00	1.9E+01	9.1E+01
Pu-238	5.5E+03	1.7E+00	4.1E+00	5.3E+00	7.5E+00
Pu-239	5.0E+03	1.7E+00	4.2E+00	5.3E+00	7.6E+00
Pu-240	5.0E+03	1.7E+00	4.2E+00	5.3E+00	7.6E+00

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Table 9.2. Subsurface Soil Cleanup Goal Area Factors⁽¹⁾

Nuclide	DCGL _w 100 m ² (pCi/g)	Area Factors (DCGL _{EMC} /DCGL _w)			
		50 m ²	10 m ²	5 m ²	1 m ²
Pu-241	9.8E+04	1.4E+00	2.6E+00	3.6E+00	7.2E+00
Sr-90	1.4E+03	1.9E+00	8.1E+00	1.5E+01	6.5E+01
Tc-99	5.0E+03	2.0E+00	9.9E+00	2.0E+01	9.8E+01
U-232	5.3E+01	1.1E+00	1.9E+00	2.8E+00	8.8E+00
U-233	7.5E+02	1.9E+00	9.0E+00	1.8E+01	8.6E+01
U-234	7.7E+02	1.9E+00	9.1E+00	1.8E+01	8.8E+01
U-235	4.3E+02	1.1E+00	1.7E+00	2.6E+00	7.8E+00
U-238	8.2E+02	1.9E+00	6.8E+00	1.0E+01	2.9E+01

NOTE: (1) From Table C-47 of Appendix C. The values in the second column are the cleanup goals (CG_w) from Table 5-14.

Table 9-3. Streambed Sediment Cleanup Goal Area Factors⁽¹⁾

Nuclide	DCGL _w 1,000 m ² (pCi/g)	Area Factors (DCGL _{EMC} /DCGL _w)					
		500 m ²	100 m ²	50 m ²	10 m ²	5 m ²	1 m ²
Am-241	1.6E+03	1.6E+00	3.0E+00	3.6E+00	5.8E+00	8.7E+00	2.5E+01
C-14	3.4E+02	2.2E+00	1.3E+01	2.8E+01	1.5E+02	3.0E+02	1.5E+03
Cm-243	3.6E+02	1.1E+00	1.2E+00	1.3E+00	2.0E+00	3.1E+00	9.1E+00
Cm-244	4.7E+03	2.0E+00	9.8E+00	1.9E+01	8.5E+01	1.6E+02	6.8E+02
Cs-137	1.3E+02	1.1E+00	1.2E+00	1.3E+00	2.1E+00	3.1E+00	9.4E+00
I-129	3.7E+02	2.0E+00	8.6E+00	1.5E+01	4.6E+01	7.7E+01	2.5E+02
Np-237	5.4E+01	1.7E+00	3.7E+00	4.6E+00	8.1E+00	1.2E+01	3.8E+01
Pu-238	2.0E+03	2.0E+00	9.9E+00	2.0E+01	9.2E+01	1.8E+02	8.1E+02
Pu-239	1.8E+03	2.0E+00	9.8E+00	1.9E+01	8.9E+01	1.7E+02	7.7E+02
Pu-240	1.8E+03	2.0E+00	9.9E+00	2.0E+01	9.3E+01	1.8E+02	8.4E+02
Pu-241	5.2E+04	1.6E+00	3.0E+00	3.7E+00	6.0E+00	9.0E+00	2.5E+01
Sr-90	9.5E+02	1.9E+00	7.1E+00	1.1E+01	2.7E+01	4.4E+01	1.4E+02
Tc-99	2.2E+05	1.8E+00	5.1E+00	7.0E+00	1.4E+01	2.1E+01	6.4E+01
U-232	2.7E+01	1.0E+00	1.2E+00	1.3E+00	2.0E+00	3.0E+00	9.5E+00
U-233	5.8E+03	1.9E+00	7.7E+00	8.7E+00	1.3E+01	2.0E+01	6.0E+01
U-234	6.1E+03	2.0E+00	9.2E+00	1.7E+01	6.2E+01	1.1E+02	4.0E+02
U-235	2.9E+02	1.0E+00	1.2E+00	1.3E+00	1.9E+00	2.9E+00	8.6E+00
U-238	1.3E+03	1.1E+00	1.4E+00	1.5E+00	2.3E+00	3.5E+00	1.1E+01

NOTE: (1) From Table C-75 of Appendix C. The values in the second column are the cleanup goals (CG_w) from Table 5-14.

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A *surrogate radionuclide* is a radionuclide in a mixture of radionuclides whose concentration is more easily measured and can be used to infer the concentrations of the other radionuclides in the mixture. If actual radioactive contamination levels are below the specified concentrations of the surrogate radionuclide, then the sum of doses from all radionuclides in the mixture would fall below the dose limit of 25 mrem/y. Tables in Section 5 do not presently show DCGL_W values for a surrogate radionuclide because available data on radionuclide distributions in soil and sediment are not sufficient to support this, but Section 5 may be revised after additional characterization data become available to provide such information.

As characterization and in-process surveys are performed, additional data would become available that could necessitate re-evaluation of the DCGLs, if, for example, assumptions used in development of the DCGLs were found to be incorrect based on the additional data. If such a situation develops, revised DCGLs would be calculated and this plan changed to incorporate the revised DCGLs and any related changes.

9.2 Types of Surveys and Their Purposes

Seven types of radiological surveys are associated with the WVDP Phase 1 proposed decommissioning project: (1) background surveys, (2) scoping surveys, (3) end-of-task surveys taken at the conclusion of deactivation activities, (4) characterization surveys, (5) in-process or remedial action support surveys, (6) Phase 1 final status surveys, and (7) confirmatory surveys. The nature of these surveys and, in some cases, the basic requirements are summarized here; more detail is provided further below on background surveys (9.3), characterization surveys (9.4), in-process surveys (9.5), and Phase 1 final status surveys (9.6).

9.2.1 Background Surveys

Background surveys are performed in non-impacted areas around the facility and in non-impacted buildings of construction similar to those impacted buildings of interest. Background surveys establish the baseline levels of radiation and radioactivity from radionuclides occurring in the environment or incorporated into the structural materials. Requirements for background surveys are summarized in Section 9.3 below.

9.2.2 Scoping Surveys

Scoping surveys are conducted (1) to provide preliminary data to supplement historical site assessment information needed to guide planning of characterization surveys, (2) to identify radionuclide contaminants, (3) to identify relative radionuclide ratios, and (4) to identify the general levels and extent of contaminants. As noted in Section 4, much of the existing radiological data associated with the WVDP proposed decommissioning project falls into the category of scoping survey data, although these data were generally not acquired as scoping survey data but were acquired for other operational needs. Additional scoping surveys are not planned for Phase 1 of the WVDP proposed decommissioning.

9.2.3 End-of-Task Surveys

As explained in Section 1, additional deactivation work will be completed in certain areas of the Process Building during deactivation work to be accomplished before the Phase 1 proposed decommissioning activities begin, and numerous ancillary project facilities will be removed during this period. After each area is deactivated and after each facility is removed, end-of-task or “final radiological characterization” surveys will be performed to define the resulting radiological conditions.

Such surveys are not within the scope of this plan since they will be completed before proposed decommissioning activities begin. However, their results will be considered in connection with defining characterization surveys and Phase 1 final status surveys to be performed during the proposed decommissioning.

9.2.4 Characterization Surveys

Characterization surveys include facility and site sampling, monitoring, and analysis activities to determine the extent and nature of residual contamination. They provide the basis for planning decommissioning actions, and providing technical information to develop, evaluate, and select appropriate remediation techniques. They also provide information for radiation protection purposes and for characterizing waste.

Four WVDP characterization survey programs have been completed: (1) the characterization program for the underground waste tanks, (2) the Facility Characterization Project, (3) a series of Resource Conservation and Recovery Act (RCRA) facility investigations performed in the 1990s, and (4) investigations of the north plateau groundwater plume using a Geoprobe[®].¹ Additionally, routine groundwater and other environmental media sampling and analysis are performed as required by DOE Orders for annual monitoring programs. The results of these programs are summarized in Section 4. The approaches used are outlined in Section 9.7 below.

As indicated in Section 4 and Section 7, additional characterization would be performed in connection with proposed decommissioning fieldwork. The requirements for this characterization are addressed in Section 9.4.

9.2.5 In-Process Surveys

In-process surveys, also referred to as remedial action support surveys, include facility and site sampling, monitoring, and analysis activities performed in support of decontamination work. They provide information necessary for radiation protection, for guiding cleanup work, for determining when field decontamination goals have been attained, and to indicate when areas are ready for Phase 1 final status surveys. Requirements for in-process surveys are discussed in Section 9.5 below.

¹ As indicated in Section 4, additional characterization of subsurface soil in the area of the north plateau groundwater plume is being undertaken in 2008. The results of this program will become available in 2009.

9.2.6 Final Status Surveys

A final status survey using MARSSIM guidance is performed to demonstrate completion of any necessary decontamination in preparation for release of the site or facility. To reflect the phased nature of the proposed decommissioning, this plan uses the terminology “Phase 1 final status” rather than “final status”. Because the decision to release or a final decision on status of the Phase 1 decommissioned areas would not be made until during Phase 2 decision making, using the terminology “final status” alone could be misinterpreted. The Phase 1 final status surveys consist of measurements and sampling to describe the radiological conditions at the close of Phase I proposed decommissioning activities. The intent is that Phase 1 final status surveys would be designed with quality, quantity and statistical objectives such that the data could be used in a MARSSIM-based “final status” evaluation in the future without a need to re-survey the areas, unless subsequent site activities influence the status. Requirements for the Phase 1 final status surveys are addressed in Section 9.6 below.

9.2.7 Confirmatory Surveys

Confirmatory surveys include limited, independent third-party measurements, sampling, and analysis to verify the results of the licensee’s final status survey. Typically, confirmatory surveys conducted by NRC or its contractor consist of two components: (1) a review of the licensee’s final status survey plan and report to identify any deficiencies in the planning, execution, or documentation, and (2) measurements taken at a small percentage of locations, previously surveyed by the licensee, to determine whether the licensee’s results are valid and reproducible. (Note that while DOE is performing the Phase 1 final status surveys as part of its responsibilities under the WVDP Act, DOE is not the licensee for any part of the Center.).

DOE anticipates that NRC will arrange for independent in-process surveys to be performed after Phase 1 proposed decommissioning work in an area is completed. DOE also anticipates that confirmatory surveys will be performed on an area basis after the Phase 1 final status survey has been completed for that area, a strategy that experience shows to be more efficient than a single confirmatory survey at the conclusion of the project. An *area* in this context may be a group of related survey units or an entire waste management area (WMA).

To facilitate NRC in-process and confirmatory surveys, DOE would:

- Keep NRC informed of the schedule and status of decommissioning activities and the Phase 1 final status survey,
- Notify NRC when particular areas are to be ready for confirmatory surveys, and
- Prepare the portion of the Phase 1 Final Status Survey Report that addresses survey results section-by-section and provide to NRC in draft form sections that describe

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DOE survey results for those areas in which NRC is to perform confirmatory surveys. Experience has shown that this practice promotes efficiency.²

9.3 Background Surveys

Some information on background radiation and radioactivity in non-impacted areas is available, such as that contained in annual site environmental reports (WVES and URS 2008) and that described in Section 4. Additional background measurements would be taken in connection with characterization surveys outlined in Section 9.4. These would include exposure rates and samples from non-impacted soil and building materials in appropriate background reference areas.

Applicable guidance in the MARSSIM (NRC 2000) and in NUREG-1505 (Gogolak, et al. 1997) would be considered. The background surveys would be described in detail in the Characterization Sample and Analysis Plan.

9.4 Characterization Surveys

As noted above, four formal characterization survey programs have been completed for portions of the project premises, routine sampling and analysis are performed annually, and additional characterization surveys would be performed in connection with Phase 1 proposed decommissioning activities. Characterization surveys performed in connection with Phase 1 proposed decommissioning activities would be described in more detail in a Characterization Sample and Analysis Plan that DOE or its contractor would issue prior to the decommissioning.

Characterization to be accomplished in connection with proposed decommissioning activities would be planned with the following objectives and guidance.

9.4.1 Characterization Sample and Analysis Plan Content

This plan would provide details of characterization surveys to be performed to more precisely determine the extent and the amount of residual radioactivity as proposed decommissioning activities begin.

Requirements and Guidance to be Followed

This plan would follow provisions in NUREG-1757 Volume 2 (NRC 2006) and applicable guidance of the MARSSIM (NRC 2000).

Radionuclides of Interest and Radionuclide Ratios

This plan would identify the radionuclides of interest. It would also address the variability of radionuclide ratios across the site and identify areas where the ratios need to be confirmed for use in the Phase 1 final status survey analysis.

² As explained in Section 9.8, DOE and the decommissioning contractor may choose to prepare multiple Phase 1 final status survey reports because of the site complexity. In this case, complete draft reports could be provided to NRC in support of the confirmatory surveys.

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Waste Acceptance Criteria

This plan would identify waste acceptance criteria for those waste disposal sites proposed to be used to establish the context for the characterization measurements.

Hazardous and Toxic Materials of Interest

This plan would identify hazardous and toxic materials to be considered during the characterization, along with the applicable concentration limits, unless characterization for hazardous and toxic materials is addressed by a separate program.

Data Quality Objectives

This plan would identify data quality objectives (DQOs) for the characterization surveys, as discussed in Section 9.4.2.

Use of Characterization Data for Final Status Survey Purposes

A key objective of this plan would be to produce data for the Phase 1 final status survey of sufficient quality and quantity to serve final status survey purposes when practicable, and this matter would be addressed in the Characterization Sample and Analysis Plan.

Background Radiation and Radioactivity

The Characterization Sample and Analysis Plan would specify appropriate measurements in reference areas for materials and structures to establish background levels, taking into account available data on background radioactivity provided in Section 4, in Appendix B, and that compiled in connection with the WVDP environmental monitoring program.

Characterization Methods for Radioactivity

This plan would specify the methods to be used to collect the necessary characterization data. Among the methods considered would be:

- Exposure rate measurements
- Surface contamination scans
- Surface contamination direct measurements
- Smear surveys for removable contamination
- Debris samples (and/or smears or metal coupons) analyzed for radionuclides of interest
- Concrete surface samples including paint
- Concrete core samples
- Surface and core samples of other materials
- Soil samples
- Water samples
- Sediment samples

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Other, more technically sophisticated characterization methods may be used as well, such as *in-situ* gamma spectroscopy and advanced characterization technologies that DOE has helped develop. Any new technology or instrumentation to be used would be shown to perform with sensitivities that allow detection of residual radioactivity at an appropriate fraction of the DCGLs and corresponding investigative levels.

Radiological Instrumentation

The Characterization Sample and Analysis Plan would specify the field and laboratory instruments to be used and the sensitivity of these instruments and methods. Table 9-4 shows typical field instruments to be addressed in the plan.

Table 9-4. Radiological Field Instruments

Survey Type	Instrument (or equivalent)	Characteristics	Approximate Sensitivity ⁽²⁾	Remarks
Exposure rate	Eberline RO-7 ⁽¹⁾	Ion chamber	> 1 R/h	For high-range readings.
Exposure rate	Eberline RO-2 ⁽¹⁾	Ion Chamber	0.1 mrem/h	For low-range readings
Exposure rate	Bicron Micro Rem	Organic scintillator	Several μ rem/h	For scanning soil, low potential areas.
Exposure rate	Ludlum 44-10 ⁽¹⁾	2-inch NaI scintillator	900 cpm/ μ R/h	For scanning soil, low potential areas.
Exposure rate	FIDLER	5-inch diameter NaI scintillator	500 cpm per uCi/m ²	For scanning soil for low energy gamma
Alpha	Ludlum 43-89 ⁽¹⁾	ZnS (Ag) scintillator, 100 cm ² probe	100 dpm/100 cm ² 85 dpm/100 cm ²	Scans 100 dpm, direct measurements 85 dpm.
Beta	Ludlum 43-89 ⁽¹⁾	ZnS (Ag) scintillator, 100 cm ² probe	2,500 dpm/100 cm ² 800 dpm/100 cm ²	Scans 2,500 dpm, direct measurements 800 dpm.
Beta-gamma	Ludlum 44-40 ⁽¹⁾	Geiger-Mueller (G-M) shielded pancake probe	3,300 cpm/mrem/h	For scanning in tight areas
Beta-gamma	Ludlum 44-9 ⁽¹⁾	G-M unshielded pancake probe	3,300 cpm/mrem/h	For scanning in tight areas
Beta-gamma	Ludlum 44-6 ⁽¹⁾	G-M sidewall detector	1,200 cpm/mrem/h	For use as a pipe probe

NOTES: (1) To be used with an appropriate scaler-ratemeter.

(2) These are approximate values based primarily on manufacturer's ratings. The sensitivities depend on background, count time, and other factors. Calculated, more precise information would be specified in the Characterization Sample and Analysis Plan.

Samples may be analyzed onsite or shipped to an offsite contract laboratory for analysis. Laboratory methods, instruments and sensitivities would be in accordance with New York State protocols for environmental analysis. Any laboratory used for environmental sample analysis would have appropriate New York State Department of Health Environmental Laboratory Approval Program certification, or equivalent.

Characterization Methods for Hazardous and Toxic Materials

This plan would specify methods used to determine the presence of hazardous and toxic materials, such as analysis for lead or polychlorinated biphenyls in paint through direct measurement by x-ray fluorescence or sampling for analysis in a laboratory, unless such surveys are covered in a separate characterization program.

Survey Locations

This plan would specify how to locate and identify sampling and measurement locations, such as how to lay out and mark appropriate size survey grids. Grid control points and positions of samples and survey readings within the grid would be located using global position system devices or conventional surveying. Class 1, Class 2, and Class 3 survey units are discussed in Section 9.6.1.

Surveys and Sampling of Individual Facilities and Areas

This plan would specify the type and extent of characterization measurements in different facilities and areas.

Surveys of Inaccessible Areas

The plan would address how areas that are inaccessible or difficult to access would be evaluated.

Characterization of Removed Materials

Characterization measurements would include those necessary for waste management purposes and the Characterization Sample and Analysis would specify the applicable requirements and guidance for characterization of materials. The decommissioning contractor would also provide a procedure for characterizing materials for waste management purposes and obtain DOE approval of this procedure. This procedure would be consistent with applicable DOE requirements and guidance, as well as any applicable State-specified waste acceptance criteria for radioactivity in the offsite landfill(s) where uncontaminated material may be disposed of. It would apply to, among other materials, surface and subsurface soil not known to have been impacted by radioactivity.

Handling Waste Generated During Characterization

The Characterization Sample and Analysis Plan would specify how to minimize and manage investigative derived waste.

Health and Safety

This plan would identify health and safety requirements associated with characterization activities; it may reference the project Health and Safety Plan for this purpose.

Quality Assurance

The Characterization Sample and Analysis Plan would address quality control and quality assurance requirements for characterization, addressing matters identified in Section 9.4.3 and referring to the Quality Assurance Project Plan as appropriate.

Supporting Procedures

This plan would specify necessary supporting procedures, such as those for obtaining, handling, preserving, and packaging samples, as well as chain of custody procedures.

Documentation

This plan would detail the requirements for formally documenting characterization data in a written report.

9.4.2 Characterization Data Quality Objectives

The Data Quality Objectives for the characterization would be detailed in the Characterization Sample and Analysis Plan; they may be briefly stated as follows:

The Problem

Available characterization data in many areas are insufficient to support proposed decommissioning activities and waste characterization and, in some cases, planning for radiation protection.

The Decision

The principal study question is what additional radiological data are needed for proposed decommissioning activities, waste management, and radiation protection. The decision statement may be expressed as follows: if collection of additional data is warranted, collect data of sufficient quality and quantity to support proposed decommissioning activities, waste characterization and/or planning for radiation protection.

Inputs to the Decision

Inputs to the decision include: (1) available data on radiological conditions; (2) professional judgment concerning data necessary to support the proposed decommissioning activities, waste management, and radiation protection; and (3) available characterization measurement methods to collect necessary additional data, such as using field instruments to determine exposure rates and contamination levels and obtaining samples of materials and having them analyzed in a laboratory.

Study Boundaries

The study boundaries include:

- The characteristics of the contaminants of interest: Various radionuclides known to be present at the site from reprocessing of spent nuclear fuel and the hazardous and toxic materials that may be present based on facility history and process history, along with the physical parameters of the facilities and areas involved, such as size, geometry, and material composition.
- The spatial boundary of the decision statement: The facilities and areas within the scope of the DP, including soil from the surface to a depth of six inches (15 cm) from the surface and, when contamination is present, down to a depth indicating the bound of sub-surface impacts.

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- The temporal boundary of the problem: The data can be acquired any time before the beginning of proposed decommissioning activities in the facility or areas involved, so long as sufficient time is allowed to make preparations based on the data. Data inside facilities can be acquired without regard to conditions such as weather, temperature, and wind. Measurements and sampling in outside areas are dependent on the weather.
- Scale of decision-making: Areas of interest would generally conform to particular areas to undergo decommissioning, i.e., decisions would be made on specific areas or survey units, rather than the project premises as a whole.
- Practical constraints on data collection: These include limited access to certain areas, radiation exposure to those collecting data, availability of personnel and equipment, laboratory capabilities and capacity, and costs. Another constraint is the risk of releasing contamination to the environment and introducing new environmental contamination transport mechanisms.

Decision Rule

The decision rule on whether or not to collect data in particular areas and how much data to collect would be addressed in the Characterization Sample and Analysis Plan. It would involve the use of project experience and professional judgment to determine the adequacy of available data and the type and extent of any additional data needed.

Limits on Decision Errors

The conclusion that a facility or area has been adequately characterized is subject to the possibility of a decision error. Decisions are based on data subject to different variabilities due to choices on sample number, location, collection, and analysis. The acceptable probability of making a decision error on the adequacy of the characterization (false positive and false negative) would be addressed.

Optimizing the Design

The content of the Characterization Sample and Analysis Plan would reflect an optimum design based on the various factors considered in its preparation, including the matters discussed above.

9.4.3 Characterization Quality Requirements

The quality requirements of Section 8 would apply to characterization. The following matters would also be addressed in the Characterization Sample and Analysis Plan.

Quality Objectives for Measurements

Objectives for precision, bias, completeness, representativeness, reproducibility, comparability and statistical confidence (control charts) would be addressed.

Field Instruments

Field instruments would be calibrated in accordance with written procedures using standards traceable to the National Institute of Standards and Technology. They would be

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calibrated every six months and following any substantial repair. Battery status, check source response, and background measurements would be performed prior to use each day, at the completion of use each day, and any time that instrument operation is in question. Control charts with specified limits of acceptability would be used to document and trend source response and background measurements.

Laboratory Instruments

Laboratory instruments such as alpha spectrometers, gamma spectrometers, low-background alpha-beta counters, and liquid scintillation counters would also be calibrated in accordance with written procedures using standards traceable to the National Institute of Standards and Technology. Appropriate operational checks such as background counts and reproducibility checks would be performed before use. Control charts with specified limits of acceptability would be used to document and trend source and background checks.

Offsite analytical laboratories would be required to meet all applicable quality requirements; the laboratory Quality Assurance Plan would be reviewed to ensure that applicable requirements are included. Offsite laboratories would be audited to assure quality performance.

Sample Chain of Custody

Sample chain of custody procedures would be established and followed to ensure that sample accountability and integrity are maintained. This process would include appropriate documentation utilized from the point of collection to the point where the sample is consumed in analysis, transferred to another organization, or properly disposed of.

Analytical Quality Control

Quality controls utilized for analytical chemical processes would include:

- Maintaining the quality of standards,
- Maintaining controls over sample flow,
- Controlling batch quality using method blanks,
- Using laboratory control standards traceable to the National Institute of Standards and Technology or using other industry-accepted standards or reference materials,
- Formally evaluating unacceptable results, and
- Utilizing process control charts as appropriate.

Data Quality Control

Data would be recorded in a legible manner and reviewed for matters such as accuracy of recording and transcription, procedure compliance, completeness, and consistency. Calculations would be checked and conclusions would be peer reviewed. Problems identified would be resolved before the data are utilized. Data reports and documents would be archived and maintained to comply with the Project Quality Assurance Program described in Section 8.

9.5 In-Process Surveys

In-process or remedial action support surveys would be performed while remediation is in progress to guide decontamination and determine when remediation to field goals (the cleanup goals specified in Section 5) has been attained. In-process surveys also support radiation protection.

Measurement methods and instruments used would be similar to those typically utilized during characterization and final status surveys. Where practicable, correlations between gamma exposure rates and soil radioactivity concentrations would be used to help determine when removal of target soil has been completed and to demonstrate that the instrument scan and direct measurement sensitivities are sufficient for the purpose of the in-process survey. Data reports and documents would be archived and maintained to comply with the Project Quality Assurance Program described in Section 8.

9.6 The Phase 1 Final Status Survey

As indicated previously, the Phase 1 final status survey would be accomplished in accordance with a Phase 1 Final Status Survey Plan(s). Because the proposed decommissioning work spans a significant period of time and area of the site, the Phase 1 final status survey efforts may be more readily described and controlled in several area-specific or survey unit-specific plans rather than a single, more complex plan. The use of the DQO process in the project planning cycle would ensure consistency in the design, execution, and evaluation of Phase 1 Final Status Survey Plans if multiple plans are developed.

This Phase 1 Final Status Survey Plan(s) would have an integrated design incorporating:

- Analysis of media samples from systematic positions to determine the average concentration of activity distributions in relatively large areas, and
- Surface scanning meter surveys to identify localized areas of elevated activity.

9.6.1 Phase 1 Final Status Survey Plan Content

The Phase 1 Final Status Survey Plan(s) would provide details of the Phase 1 final status surveys to demonstrate that residual radiological conditions satisfy the cleanup criteria described in Section 9.1 or to document final radiological conditions as indicated below. (The plan elements described below would apply to all Phase 1 Final Status Survey Plans if multiple plans are prepared.)

Requirements and Guidance to be Followed

The Phase 1 Final Status Survey Plan would follow provisions in NUREG-1757 Volume 2 (NRC 2006) and guidance of the MARSSIM (NRC 2000).

Overview of Survey Design

This plan would provide a brief overview of the survey design. This design would closely follow NUREG-1757 Volume 2 (NRC 2006) and the MARSSIM (NRC 2000), utilizing statistical tests to determine adequate sample density.

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Radionuclides of Interest

This plan would specify the radionuclides of interest identified in Section 9.1, considering that all radionuclides may not be of interest in certain areas.

Designating Residual Radioactivity Limits and Investigative Levels

This plan would identify the cleanup criteria specified in Section 5. It would also identify investigative levels and how they were established.

Use of Characterization Data for Phase 1 Status Survey Purposes

As indicated previously, DOE plans to produce characterization data of sufficient quality to serve Phase 1 final status survey purposes when practicable for areas that appear to meet the cleanup criteria without the need for remediation, and this matter and the data of interest would be addressed in the Phase 1 Final Status Survey Plan.

Consideration of In-Process Survey Data

Any useful available data compiled during in-process surveys would be summarized in the Phase 1 Final Status Survey Plan and its use to estimate survey unit variance and confirm survey unit classification would be addressed.

Additional Radioactivity Not Accounted For During Characterization

If any radioactivity from licensed or WVDP operations is not accounted for by characterization performed previously or in connection with proposed decommissioning activities, this would be identified in the Phase 1 Final Status Survey Plan.

Classification of Areas

Different areas of the project premises facilities and areas of interest would be classified based on potential for radioactive contamination. Four classifications would be used:

- Class 1: impacted areas that, prior to remediation, are expected to have concentrations of residual radioactivity that exceed the DCGL_W;

- Class 2: impacted areas that, prior to remediation, are not likely to have concentrations of residual radioactivity that exceed the DCGL_W;

- Class 3: any impacted areas that have a low probability of containing residual radioactivity; and

- Non-impacted: areas without reasonable potential for radioactive contamination from licensed or WVDP activities.

Impacted areas are identified in Section 4 based on information available in 2008. Preliminary classification would be confirmed or adjusted based on subsequent characterization and in-process survey data.

Survey Units

Survey units are geographical areas of specified size and shape for which a separate decision would be made as to whether or not that area exceeds the regulatory limit. Areas within a survey unit would have a similar usage history and contamination potential and be contiguous areas of the same area classification.

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Survey units would be specified in the Phase 1 Final Status Survey Plan. They would be identified in tables or drawings or a combination of the two. Among areas considered in designating survey units would be:

- Exposed surface areas of the WMA 1 and WMA 2 excavations before they are back-filled;
- Exposed surface areas of the excavations following removal of foundations and floor slabs; and
- Surface soil and stream sediment throughout the project premises.

In some survey units, data from characterization would be sufficient for Phase 1 final status survey purposes; this matter would be addressed in the Phase 1 Final Status Survey Plan.

Background Radiation and Radioactivity

Appropriate measurements would be taken in non-impacted background reference areas to establish background levels, taking into account available data on background summarized in Section 4, in Appendix B, that compiled in connection with the WVDP environmental monitoring program, and that collected during characterization. Media background would be subtracted from Phase 1 final status survey results.

Data Quality Objectives

Data Quality Objectives for the Phase 1 final status survey would be established as indicated in Section 9.6.2.

Survey Methods

The methods to be used to collect the necessary data in Phase 1 final status surveys would be similar to methods used in characterization surveys discussed previously. Among these are:

- Surface contamination scans,
- Direct measurements for contamination,
- Exposure rate measurements, and
- Soil and/or other media samples.

The Phase 1 Final Status Survey Plan would incorporate performance-based measurement systems, specifying the analytical sensitivity goal of each survey method. Individual methods (i.e., static surface counts) would then be translated to field procedures (instrument, detector, geometry, and count time) to assure attainment of the sensitivity required. Information necessary to perform the surveys and sampling, such as procedures for collecting and preparing samples, would be specified. Other survey methods may be used in support of the methods specified above, such as gamma scans to help identify locations of soil samples.

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Radiological Instrumentation

This plan would specify the field and laboratory instruments to be used and the sensitivity of these instruments and methods. Table 9-5 shows typical field instruments to be addressed in the plan.

Table 9-5. Radiological Field Instruments for Phase 1 Final Status Survey

Survey Type	Instrument (or equivalent)	Characteristics	Approximate Sensitivity ⁽¹⁾	Remarks
Exposure rate	Bicron Micro Rem	Organic scintillator	Several $\mu\text{rem/h}$	For scanning soil.
Exposure rate	Ludlum 44-10	2-inch NaI scintillator	900 cpm/ $\mu\text{R/h}$	For scanning soil.
Exposure Rate	FIDLER	5-inch diameter NaI scintillator	500 cpm per $\mu\text{Ci/m}^2$	For scanning soil for low energy gamma

NOTE: (1) These are approximate values based primarily on manufacturer's ratings. The sensitivities depend on background, count time, and other factors. Calculated, more precise information would be specified in the Phase 1 Final Status Survey Plan.

The Phase 1 Final Status Survey Plan would specify how the minimum detectable concentration (MDC) for media samples and the MDC for scanning surveys (MDC_{scan}) would be determined for each instrument and technique using methods specified in NUREG-1757, Volume 2 (NRC 2006). It would also demonstrate that the instrument scan and direct measurement sensitivities are consistent with MARSSIM (NRC 2000) guidance and sufficient for the goals of the Phase 1 final status survey.

The laboratory instruments and methods to be utilized would also be addressed in the Phase 1 Final Status Survey Plan, along with the minimum detectable concentrations of the methods used. Instruments and methods are expected to be similar to those shown in Table 9-7.

Scan Surveys

Scan surveys of survey units of the different classifications would be performed as indicated in Table 9-6 below. The purpose of such scan surveys is to identify small areas of elevated activity.

Table 9-6. Scan Surveys for Different Survey Area Classifications

Classification	Scanning Required	Scanning Investigative Levels
Class 1	100% coverage ⁽¹⁾	$>\text{DCGL}_{\text{EMC}}$
Class 2	10-100% coverage ⁽²⁾	$>\text{DCGL}_W$ or $>\text{MDC}_{\text{scan}}$ if MDC_{scan} is greater than DCGL_W .
Class 3	Judgmental	$>\text{DCGL}_W$ or $>\text{MDC}_{\text{scan}}$ if MDC_{scan} is greater than DCGL_W .
Non-impacted	None	Not applicable.

NOTES: (1) Entire surface of soil areas (and exposed building floor slabs and foundations, if any).

(2) Surveys would be both systematic and judgmental.

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The derivation of scan and fixed MDCs would take into account instrument efficiencies (surface and detector), scan rates and distances over surfaces, surveyor efficiency, and minimum detectable count rate, using guidance in the MARSSIM (NRC 2000) and NUREG-1507 (Abelquist, et al. 1998).

Sample Collection and Handling

A brief description of how samples are to be collected, controlled, and handled would be provided, with reference to the detailed procedure(s) to be used for this purpose.

Survey Grids

Survey grids of appropriate size would be laid out and marked on excavations and land areas. Where practicable, grids established for characterization surveys would be re-established for use in the Phase 1 final status survey. Grid control points and positions of samples and survey readings within the grid would be located using global position system devices or conventional surveying.

Surrogate Radionuclides

Surrogate measurements focusing on Cs-137 may be used in areas where the radionuclide mix in a survey unit is consistent and Cs-137 is one of the dominant radionuclides. The Phase 1 Final Status Survey Plan would specify how this would be done in particular areas.

Surveys and Sampling of Individual Facilities and Areas

This plan would specify the process to determine the number of samples required in different areas following MARSSIM protocols. This process would include the following elements:

- Developing DQOs consistent with the requirements in Section 9.6.2,
- Utilizing as the null hypothesis (H_0) to be tested the assumption that the residual contamination exceeds the release criteria with the alternative hypothesis (H_A) being that the residual contamination meets the release criteria,
- Determining the relative shift – a ratio involving the difference between the $DCGL_W$ and the field remediation concentration goal divided by the variability in the concentration across the survey unit following remediation,
- Determining acceptable decision errors,
- Determining the number of samples needed for the Wilcoxon rank sum test (for radionuclides present in background),
- Determining the number of samples needed for the Sign test (for radionuclides not present in background), and
- Determining the number of additional samples needed if the MDC_{scan} is greater than the $DCGL_W$.

Evaluation of Results and Determination of Compliance

The measurement data would be first reviewed to confirm that the survey units were properly classified. In any cases where the results show that an area was misclassified with a less restrictive classification, the areas would be reclassified correctly, and a survey appropriate to the new classification would be performed.

Whether the measurement results demonstrate that the survey unit meets the release criteria would then be determined. The process for this and the statistical tests to be used would be specified in the Phase 1 Final Status Survey Plan, taking into account the multiple radionuclides present at the site and the different radionuclide distributions present in some areas.

If compliance is not demonstrated, then additional remediation followed by additional Phase 1 final status surveys would be performed until the release criteria are achieved.

Two radionuclides (I-129 and Np-237) in surface soil would be treated as special cases because their cleanup goals are lower than the minimum detectable concentrations in typical laboratory sample analyses. Section 7 of the MARSSIM indicates that the analytical detection limits should be 10-50 percent of the DCGL, but that higher detection sensitivities may be acceptable when lower limits are impracticable (NRC 2000). Because these two radionuclides should not appear in background soil samples, analysis at a detection limit near the DCGL would be sufficient to flag results should a sample indicate the presence of either radionuclide above its detection limit.

The Phase 1 Final Status Survey Plan would provide an alternate method for evaluating analytical results for these radionuclides that do not exceed the minimum detectable concentrations. This alternate method may involve use of an easy to detect surrogate radionuclide prevalent in surface soil, such as Cs-137 or Am-241, to infer the concentration of I-129 and Np-237. Scaling factors for spent fuel reprocessed specified in Table 4-1 would be suitable for this purpose. Another suitable alternate evaluation method could involve larger soil volumes and longer counting times for representative samples to reduce the minimum detectable concentration to a value below the cleanup goal.

The amounts of I-129 and Np-237 that might be found in surface soil contamination, if any, would be small. This conclusion is based on comparisons between the estimated amounts of these radionuclides at the site at the conclusion of spent fuel reprocessing compared to the estimated amounts of predominant radionuclides such as Sr-90 and Cs-137. Table 2-5 in Section 2 shows estimates for the radionuclide content of the underground waste tanks at the completion of reprocessing. This table shows the estimated amount of I-129 to be more than seven orders of magnitude less than the estimated Cs-137 present, with the estimated amount of Np-237 more than six orders of magnitude less than the estimated Cs-137 amount.³

³ Although Np-237 is produced during radioactivity decay of Am-241, this factor is accounted for in the RESRAD model, which accounts for the progeny of the radionuclides of interest.

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Health and Safety

This plan would identify health and safety requirements associated with survey activities; it may reference the project Health and Safety Plan for this purpose.

Quality Assurance

The Phase 1 Final Status Survey Plan would address quality control and quality assurance requirements for characterization, addressing matters identified in Section 9.6.3 and in Section 8, referring to the project Quality Assurance Plan as appropriate.

Supporting Procedures

This plan would specify necessary supporting procedures, such as those for obtaining and managing samples.

Documentation

This plan would detail the requirements for formally documenting and archiving Phase 1 final status survey data, in accordance with the requirements of Section 9.8.

9.6.2 Data Quality Objectives for the Phase 1 Final Status Survey

The DQOs would be detailed in the Phase 1 Final Status Survey Plan; they would involve considerations such as:

- Stating the problem: Provide adequate data of sufficient quality to determine the extent and magnitude of residual radioactive contamination.
- Identifying the decision: Will the data generated be adequate to support all survey objectives?
- Identifying inputs to the decision: Available data, including final characterization data obtained in connection with deactivation, information needed, measurement methods that would produce necessary data.
- Defining the study boundaries: Radionuclides of interest, areas of interest, necessity to obtain data to support the proposed decommissioning schedule, appropriate-sized units, limited access to certain areas, availability of personnel and equipment, laboratory analysis throughput.
- Developing a decision rule: How to make the judgment as to whether or not additional data would need to be collected.
- Specifying limits on decision error: Consider the consequences of inadequate survey data and express what is acceptable in this regard.
- Optimizing the design: Data quality assessment would be used to determine the validity and performance of the data collection design and determine the adequacy of the data set to support the decision.

9.6.3 Phase 1 Final Status Survey Quality Requirements

The quality requirements of Section 8 would apply, along with the quality requirements for the characterization survey as identified in Section 9.4.3. These matters would be addressed in the Phase 1 Final Status Survey Plan.

9.7 The Survey Process By Waste Management Area

This section outlines surveys completed and surveys to be accomplished in each WMA (9.7.1 through 9.7.11) and, separately, surveys completed and planned for environmental media across the project premises (9.7.12). Note that other considerations such as proposed decommissioning activities in adjacent areas and the impact of routes for transportation of radioactive materials on survey units and area classification would be addressed as appropriate in the Phase 1 Final Status Survey Plan(s).

9.7.1 WMA 1 Process Building and Vitrification Facility Area

Characterization surveys of the Process Building and Vitrification Facility have been performed in connection with the Facility Characterization Project. However, because radiological conditions in most building areas would change during deactivation work performed before the start of the proposed decommissioning, additional surveys would be performed as proposed decommissioning activities begin. Characterization of the contaminated soil in WMA 1 that is the source for the north plateau groundwater plume is addressed in Section 4.2; surveys related to its remediation are addressed in Section 9.7.12 below.

The Facility Characterization Project

As noted previously, the Facility Characterization Project focused on development of conservative source term estimates for various areas of the Process Building and Vitrification Facility. It followed the MARSSIM (NRC 2000) process and was carried out in accordance with the WVNSCO Characterization Management Plan (Michalczak 2004).

Description of Previous Survey Measurements. The primary process for determining the source term in a particular area involved using exposure rate measurements to quantify the amount of a surrogate gamma-emitting radionuclide such as Cs-137, and using scaling ratios to estimate the amounts of other radionuclides present. Scaling ratios were based on sample analysis, process knowledge, or other bounding assumptions. In some cases, samples were collected and the analytical results were used in calculating a source term based on surface area or volumetric computations.

The process entailed four basic steps: (1) collection and evaluation of existing data and preparation of a draft technical approach, (2) review of these data and the proposed approach by a Technical Review and Approval Panel, (3) collection of any needed data and modeling to estimate the source term, and (4) review and concurrence on the estimated source term by the Panel. Where additional data were needed, a biased sampling approach was used that typically involved field measurements such as radiation and contamination levels, along with samples of materials analyzed in a laboratory. Radiation level measurements were typically taken with a Geiger-Mueller

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detector (Ludlum Model 133-6) or ion chamber (Eberline RO-20) attached to a scaler/rate meter. Smears were counted with a Tennelec gas-flow proportional counter. Detection sensitivities for the exposure rate instruments were approximately 0.1 mrem/h for the RO-20 and higher for the Model 133-6, whose scales range from 1 mR/h to 1000 R/h.

Due to the high activity associated with most of the samples, samples taken in connection with the project were analyzed in the former onsite Analytical and Process Chemistry Laboratory. Table 9-7 shows laboratory instruments and methods, along with their sensitivities.

Table 9-7. Laboratory Methods

Nuclide	Instrument/Method	WVDP Procedure	Approximate Sensitivity ⁽¹⁾
Am-241	Alpha and/or gamma spectrometry	ACM-2707/3104	1.0 E-05 µCi/g
C-14	Sample oxidizer and liquid scintillation	ACM-4904	1.0 E-02 µCi/g
Cm-234/244	Alpha and/or gamma spectrometry	ACM-2707/3104	1.0 E-03 µCi/g
Cs-137	Gamma spectrometry	ACM-3103/3104	1.0 E-03 µCi/g
I-129	Gamma spectrometry	ACM-3104	1.0 E-03 µCi/g
Np-237	Alpha and/or gamma spec	ACM-2707/3104	1.0 E-03 µCi/g
Sr-90	Liquid scintillation	ACM-2707/3002	1.5 E-05 µCi/g (1g sample)
Tc-99	Gas flow proportional counting	ACM-4001	1.0 E-06 µCi/g (1g sample)
Pu-238	Alpha spectrometry	ACM-2704	1.0 E-05 µCi/g
Pu-239/240	Alpha spectrometry	ACM-2704	1.0 E-05 µCi/g
Pu-241	Liquid scintillation	ACM-2707/2708	1.0 E-05 µCi/g
U-232	Alpha spectrometry	ACM-2707	1.0 E-05 µCi/g
U-233/234	Alpha spectrometry	ACM-2707	1.0 E-05 µCi/g
U-235 (-236)	Alpha spectrometry	ACM-2707	1.0 E-05 µCi/g
U-238	Alpha spectrometry	ACM-2707	1.0 E-05 µCi/g

NOTES: (1) Dependent on sample size, counting time, etc.

Formal quality assurance requirements were implemented. Data quality objectives following the MARSSIM (NRC 2000) process were used. Data collected were compiled into individual reports for the area or facility. Each report included a discussion of available historical data, the approach used to gather additional data, and the conservatively bounding source term estimate, along with all the supporting information.

Justification for Previous Survey Measurements. The focus on conservative source terms supported one of the decommissioning alternatives envisioned by DOE when the Facility Characterization Project began. This alternative would have entailed leaving most of the Process Building and Vitrification Facility in place beneath a multi-layer cap.

The focus on source term estimates rather than general radiological conditions produced information important to the performance assessment under this alternative.

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The process for collection and evaluation of historical data was similar to that used for historical site assessments. Data acquired during the effort were obtained following MARSSIM quality protocols. However, these data are being treated as scoping survey data in some cases because of their limited extent.

Process Building and Vitrification Facility Characterization Surveys

In connection with proposed decommissioning activities in each area, characterization measurements would be taken as specified in the Characterization Sample and Analysis Plan. The measurements would take into account data from deactivation end-of-task surveys and fill in data gaps for areas where these surveys were not performed. Characterization measurements would be performed on the WMA 1 facilities commensurate with plans for their disposition, which is removal in each case. As indicated in Section 7, there are no plans to release these facilities from radiological controls before dismantlement or demolition, which limits characterization data needs.

Description of Planned Survey Measurements. Measurements would typically include exposure rates, removable contamination, and total contamination. Samples would be analyzed for specific radionuclides to confirm radionuclide distributions where such information is not already available and to provide information for radiation protection and waste characterization. Areas inaccessible to surveys would be exposed so surveys can be made where indicated in the Characterization Sample and Analysis Plan.

Justification for Planned Survey Measurements. These are the appropriate measurements necessary to facilitate radiation protection and support planning decommissioning activities and waste management.

Process Building and Vitrification Facility In-Process Surveys

In-process surveys would be performed during remediation as specified in Section 9.5.

Process Building and Vitrification Facility Area Phase 1 Final Status Surveys

As explained previously, the final end-state of the Process Building and Vitrification Facility would involve total removal including excavation of the subsurface portions, backfilling with soil, and installing a vertical hydraulic barrier wall on the down-gradient side of the excavation footprint. Phase 1 final status surveys would be performed for exposed subsurface areas before they are backfilled; this matter would be addressed in the Phase 1 Final Status Survey Plan, which would provide details of the surveys required.

Process Building and Vitrification Facility Area Confirmatory Surveys

After Phase 1 final status surveys are completed, arrangements would be made to have any desired confirmatory surveys performed.

Characterization of Other WMA 1 Facilities

The other facilities to remain within WMA 1 after 2008 that may have been impacted by radioactivity are: (1) the 01-14 Building, (2) the Plant Office Building, (3) the Utility Room, and (4) the Utility Room Expansion. Because these facilities would be entirely or partially within the bounds of the planned excavation, characterization measurements would be performed

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on these WMA 1 facilities commensurate with plans for their disposition, which is removal in each case. As indicated in Section 7, there are no plans to release these facilities from radiological controls before dismantlement or demolition, which limits characterization data needs.

Routine WVDP surveys taken through mid-2008 in these areas have typically not shown removable contamination above detection limits. However, contamination from the major acid spill during NFS operations that produced the north plateau groundwater plume is known to be present beneath the floor in the men's shower room of the Plant Office Building. And some areas in the 01-14 Building, such as areas on the third and fourth floor that contain ventilation system equipment, are not routinely surveyed.

Description of Planned Survey Measurements. Measurements would typically include exposure rates, removable contamination, and total contamination. Representative embedded piping in the 01-14 Building floor slab, except for sealed floor drains, would be characterized, with measurements such as (1) total beta using a suitable pipe probe (such as a Ludlum 44-6 sidewall detector) in the exposed ends of the pipe, (2) removable alpha and beta contamination in the ends of the pipe by smears, and (3) exposure rates on the accessible piping. (Note that some equipment would be removed from the 01-14 Building during deactivation.)

Characterization is not planned for the non-impacted facilities in WMA 1 – the Fire Pump House and water tank and the electrical substation.

Justification for Planned Survey Measurements. These are the appropriate measurements necessary to facilitate radiation protection and support planning decommissioning activities and waste management.

In-Process Surveys of Other WMA 1 Facilities

In-process surveys would be performed during remediation as described in Section 9.5. However, the scope of such surveys would be minimal because of the relative low potential for contamination, except in some areas of the 01-14 Building which may contain significant contamination.

Phase 1 Final Status Surveys in Other WMA 1 Facilities

As all facilities within the Process Building excavation would be removed, the Phase 1 final status surveys would be surveys of the excavation surface in accordance with the Phase 1 Final Status Survey Plan.

Confirmatory Surveys in Other WMA 1 Areas

After Phase 1 final status surveys are completed, arrangements would be made to have any desired confirmatory surveys of these areas performed.

Characterization of Subsurface Piping in WMA 1

DOE has evaluated contaminated underground piping (Luckett, et al. 2004). This evaluation produced conservative source term estimates based on existing data, but it did not include characterization measurements. Subsurface piping within the bounds of the WMA

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1 excavation would be removed, packaged and disposed of at offsite disposal facilities. There is no intent in Phase 1 of the proposed decommissioning to trace or excavate underground piping outside the bounds of the excavation.

When these lines become exposed during the course of proposed decommissioning work, measurements would be taken as necessary, for instance for waste characterization purposes for lines removed or to provide data to support Phase 2 decision-making for portions of lines remaining in place.

Description of Survey Measurements. The measurements would be taken after the interior surfaces of the lines are exposed during the course of proposed decommissioning work. Three types of measurements would be taken as appropriate: (1) total beta using a suitable pipe probe (such as a Ludlum 44-6 sidewall detector) in the exposed ends of the pipe, (2) removable alpha and beta contamination in the ends of the pipe by smears, and (3) exposure rates on the accessible piping. Where sufficient data on radionuclide distributions are not available, smears or metal coupons would be obtained and analyzed to determine the radionuclide distributions.

Justification for Survey Measurements. These measurements would provide information on interior contamination levels that would support radiation protection, waste management, and subsequent disposition determinations. The lines have a constant downward slope and ones that carried higher concentrations of radioactive liquid are made of stainless steel. This design makes contamination traps unlikely and contamination levels in areas where piping would be cut are expected to be representative of the entire length. Line 7P120 that carried THOREX waste from the Chemical Process Cell to Tank 8D-4 is expected to contain the most residual radioactivity.

In-Process Surveys Related to Subsurface Piping in WMA 1

In-process surveys would be performed during removal of piping as described in Section 9.5. Some characterization surveys would effectively be in-process surveys since they would be performed in conjunction with piping removal activities.

Phase 1 Final Status Surveys of Subsurface Piping in WMA 1

Separate Phase 1 final status surveys of the piping not encountered during excavation and subsequently abandoned in place are not planned; characterization survey data are intended to serve Phase 1 final status survey purposes.

Confirmatory Surveys of Subsurface Piping in WMA 1

Arrangements would be made for any confirmatory surveys NRC desires to be accomplished at the time when the piping ends are accessible prior to excavation backfilling.

9.7.2 WMA 2 Low-Level Waste Treatment Facility Area

Of the facilities to remain within WMA 2 after 2008 that have been impacted by radioactivity, significant characterization data are available for only one: the Old Interceptor.

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Only limited data on radiological conditions are available for the others within the scope of the plan: (1) the LLW2 Building, (2) the Neutralization Pit, (3) the Solvent Dike, (4) the twin New Interceptors, and (5) the North Plateau Groundwater Pump and Treat Facility.

Note that the five lagoons in WMA 2 are addressed as environmental media in Section 9.7.12 below.

Existing Characterization Data for Old Interceptor

Description of Previous Survey Measurements on Old interceptor. Two radiation surveys taken in 2003 show levels up to 408 mrem/h (WVNSCO 2003a and WVNSCO 2003b)⁴.

Justification for Previous Survey Measurements. While these surveys provided useful information, they did not completely characterize the facility, which is expected to contain contamination in depth and contamination covered by a layer of concrete added to the floor.

Characterization of WMA 2 Facilities

Characterization measurements would be performed on the WMA 2 facilities commensurate with plans for their disposition, which is removal in each case. As indicated in Section 7, there are no plans to release these facilities from radiological controls before dismantlement or demolition, which limits characterization data needs.

Description of Planned Survey Measurements. Measurements would typically include exposure rates, removable contamination, total contamination, and core samples of facility surfaces in cases where they would produce information of value. Smears or samples of building materials would be obtained and analyzed to provide information on radionuclide distributions.

Justification for Planned Survey Measurements. These are the appropriate measurements necessary to facilitate radiation protection and support proposed decommissioning activities and waste management.

In-Process Surveys of WMA 2 Area

In-process surveys would be performed during remediation as described in Section 9.5. These surveys would include the surface of the soil in excavations made during removal of the interceptors, the Neutralization Pit, and the associated valve pits.

Phase 1 Final Status Surveys in WMA 2 Areas

After proposed decommissioning activities are completed in these areas, Phase 1 final status surveys would be performed in each survey unit in accordance with the Phase 1 Final Status Survey Plan. These surveys would include the exposed soil in the large excavation made to remove Lagoons 1-3, the interceptors, the Neutralization Pit, and Solvent Dike. Also

⁴ Although no radioisotope inventory report was issued for the Old Interceptor, these radiation surveys were taken for characterization purposes for the Facility Characterization Project.

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considered in the Phase 1 final status surveys would be the exposed soil surfaces from removal of remaining floor slabs and foundations of facilities removed prior to the start of decommissioning: the 02 Building, the Test and Storage Building, the Vitrification Test Facility, the Maintenance Shop, the Maintenance Storage Area, the Vehicle Maintenance Shop, and the Industrial Waste Storage Area. Phase 1 final status surveys would also be performed in the excavation to remove the Maintenance Shop leach field equipment.

Confirmatory Surveys in WMA 2 Areas

After the Phase 1 final status surveys are completed, arrangements would be made to have confirmatory surveys performed. NRC or its contractor would be afforded an opportunity to perform confirmatory surveys in excavations before they are filled in.

Characterization of Subsurface Piping in WMA 2

Underground piping within WMA 2 is comprised primarily of Duriron wastewater drain lines leading to the Interceptors and interconnecting with equipment in the treatment buildings, the interceptors, and the lagoons. Also within WMA 2 is a portion of the Leachate Transfer Line from the NRC-Licensed Disposal Area (NDA).

Subsurface piping within the bounds of the WMA 2 excavations would be removed, packaged and disposed of at offsite disposal facilities. There is no intent in Phase 1 of the proposed decommissioning to trace or excavate underground piping outside the bounds of the excavations.

When these lines become exposed during excavation of the WMA 2 Facilities, during removal of the LLW2 Building floor slab and foundations, and during removal of Lagoons 4 and 5, measurements would be taken as necessary, for instance for waste characterization purposes for lines removed or to provide data to support Phase 2 decision-making for portions of lines remaining in place.

Description of Survey Measurements. Measurements would be taken after the interior surfaces of the lines are exposed when the lines are cut. Two types of measurements would be taken: (1) removable alpha and beta contamination in the end of the pipe measured by smears, and (2) exposure rates of the accessible piping.

Justification for Survey Measurements. These measurements would provide information to support for waste characterization purposes and to support decision-making for Phase 2 of the proposed decommissioning. .

In-Process Surveys Related to Subsurface Piping in WMA 2

In-process surveys during excavation as subsurface piping is encountered during remediation would be performed as specified in Section 9.5.

Phase 1 Final Status Surveys of Subsurface Piping in WMA 2

Separate Phase 1 final status surveys of the piping not encountered during excavation and subsequently abandoned in place are not planned; characterization survey data are intended to serve Phase 1 final status survey purposes.

Confirmatory Surveys of Subsurface Piping in WMA 2

Arrangements would be made for any confirmatory surveys NRC desires to be accomplished at the time when the piping ends are accessible, prior to the excavation being filled in.

9.7.3 WMA 3, Waste Tank Farm Area

Four facilities or groups of equipment within WMA 3 have been impacted by radioactivity and are within the scope of the plan: (1) the mobilization and transfer pumps in Tanks 8D-1, 8D-2, 8D-3, and 8D-4, (2) the piping and equipment in the HLW transfer trench, (3) the Equipment Shelter and Condensers, and (4) the Con-Ed Building. Limited data on radiological conditions are available for these facilities and this equipment as indicated in Section 4.

WMA 3 Facility Characterization Surveys

Characterization measurements would be performed in connection with proposed decommissioning activities.

Description of Planned Survey Measurements. Measurements would typically include exposure rates, removable contamination, and total contamination in areas of interest.

Justification for Planned Survey Measurements. These are the appropriate measurements necessary to facilitate radiation protection and support proposed decommissioning activities and waste management.

WMA 3 Facility In-Process Surveys

In-process surveys would be performed during remediation as specified in Section 9.5.

WMA 3 Facility Phase 1 Final Status Surveys

After proposed decommissioning activities are completed in this area, Phase 1 final status surveys would be performed in accordance with the Phase 1 Final Status Survey Plan. Procedures and detection levels for scan surveys may be modified due to the higher ambient radiation levels in the area from radioactivity in the HLW tanks.

WMA 3 Confirmatory Surveys

Arrangements would be made for any confirmatory surveys desired by NRC or its contractor.

WMA 4, Construction and Demolition Debris Landfill

This landfill, which was closed in 1986, is not within the scope of the Phase 1 decommissioning work.

9.7.4 WMA 5 Waste Storage Area

Facilities within WMA 5 impacted by radioactivity and within the scope of the plan are the Remote Handled Waste Facility and Lag Storage Addition 4 and its associated Shipping

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Depot. Other facilities in WMA 5 within the scope of the plan are concrete pads and foundations remaining from facilities removed prior to the start of decommissioning.

Characterization of the Remote Handled Waste Facility

Characterization measurements would be performed in this building commensurate with plans for its disposition, which is removal.

Description of Planned Survey Measurements. Measurements would typically include exposure rates, removable contamination, and total contamination. Representative smears would be analyzed for radionuclides of interest.

Justification for Planned Survey Measurements. These are the appropriate measurements necessary to facilitate radiation protection and support proposed decommissioning activities and waste management.

In-Process Surveys Related to the Remote Handled Waste Facility

In-process surveys would be performed during remediation as specified in Section 9.5.

Phase 1 Final Status Surveys of the Remote Handled Waste Facility Excavation

As explained previously, this facility would be completely removed. After proposed decommissioning activities are completed, including demolition and removal of the floor slab and foundation and removal of the empty underground tank vault, Phase 1 final status surveys on the exposed excavation surface would be performed in accordance with the Phase 1 Final Status Survey Plan.

Confirmatory Surveys of the Remote Handled Waste Facility Excavation

After the Phase 1 final status surveys are completed, arrangements would be made to have any desired confirmatory surveys accomplished by the NRC or its contractor.

Characterization of Subsurface Piping in WMA 5

Within WMA 5 is underground piping running from the Remote-Handled Waste Facility to Tank 8D-3. Portions of this piping within the bounds of the building excavation would be removed, packaged and disposed of at offsite disposal facilities. As indicated in Section 7, the portion of the piping outside of the building excavation would remain in place unless it has been impacted by radioactivity.

When these lines become exposed during excavation to remove the Remote-Handled Waste Facility, measurements would be taken to confirm the radiological status for waste characterization purposes for lines removed and to provide data to support Phase 2 decision-making for the portions of the piping to remain in place.

Description of Survey Measurements. Measurements would be taken after the interior surfaces of the lines are exposed when the lines are cut. Two types of measurements would be taken: (1) removable alpha and beta contamination in the end of the pipe measured by smears, and (2) exposure rates of the accessible piping.

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Justification for Survey Measurements. These measurements would provide information to support for waste characterization purposes and to support decision-making for Phase 2 of the proposed decommissioning.

In-Process Surveys Related to Subsurface Piping in WMA 5

In-process surveys during excavation as subsurface piping is encountered during remediation would be performed as specified in Section 9.5.

Phase 1 Final Status Surveys of Subsurface Piping in WMA 5

Separate Phase 1 final status surveys of the piping not encountered during excavation and subsequently abandoned in place are not planned; characterization survey data are intended to serve end Phase 1 final status survey purposes.

Confirmatory Surveys of Subsurface Piping in WMA 5

Arrangements would be made for any confirmatory surveys NRC desires to be accomplished at the time when the piping ends are accessible, prior to the excavation being filled in.

Characterization of Lag Storage Addition 4/Shipping Depot

Characterization measurements would be performed in this building commensurate with plans for its disposition, which is removal.

Description of Planned Survey Measurements. Measurements would typically include exposure rates, removable contamination, and total contamination.

Justification for Planned Survey Measurements. These are the appropriate measurements necessary to facilitate radiation protection and support proposed decommissioning activities and waste management.

In-Process Surveys Related to Lag Storage Addition 4/Shipping Depot

In-process surveys would be performed during remediation as specified in Section 9.5.

Phase 1 Final Status Surveys of the Lag Storage Addition 4/Shipping Depot Excavation

As explained previously, these facilities would be completely removed. After proposed decommissioning activities are completed in this area, including demolition and removal of the floor slab and foundation, Phase 1 final status surveys on the exposed excavation surface would be performed in accordance with the Phase 1 Final Status Survey Plan.

Confirmatory Surveys of the Lag Storage Addition 4/Shipping Depot Excavation

After Phase 1 final status surveys are completed, arrangements would be made to have any desired confirmatory surveys accomplished by the NRC or its contractor.

Phase 1 Final Status and Confirmatory Surveys of Other Floor Slabs and Foundations

Also considered in the Phase 1 final status surveys and confirmatory surveys would be the soil surfaces exposed following excavations of remaining floor slabs and foundations of

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impacted facilities removed prior to the start of decommissioning. The facilities of interest are the Lag Storage Building and its additions, the Chemical Process Cell Waste Storage Area, and several hardstands and gravel pads.

After surveys specified in the Phase 1 Final Status Survey Plan are completed, the areas of interest would be made available to NRC or its contractor for any desired confirmatory surveys.

9.7.5 WMA 6 Central Project Premises

In WMA 6, the facilities to be removed during Phase 1 include the Sewage Treatment Plant, the Equalization Tank, the Equalization Basin, the two demineralizer sludge ponds, and the south Waste Tank Farm Test Tower, along with remaining floor slabs and foundations, including the underground structure of the Cooling Tower. The Equalization Basin and the two demineralizer sludge ponds are addressed along with other environmental media in Section 9.7.12.

Characterization of the Remaining Part of the Cooling Tower

The only WMA 6 structure known to have been impacted by radioactivity as of 2008 is the remaining part of the Cooling Tower. Characterization measurements would be performed in this structure commensurate with plans for its disposition, which is removal.

Description of Planned Survey Measurements. Measurements would typically include exposure rates, removable contamination, and total contamination. Representative smears would be analyzed for radionuclides of interest.

Justification for Planned Survey Measurements. These are the appropriate measurements necessary to facilitate radiation protection and support proposed decommissioning activities and waste management.

Phase 1 Final Status and Confirmatory Surveys Following Removal of Floor Slabs and Foundations

After the structures and their floor slabs and foundations have been removed, the exposed soil surface of the resulting excavations would be considered in the Phase 1 final status surveys. After surveys specified in the Phase 1 Final Status Survey Plan are completed, the areas of interest would be made available to NRC or its contractor for any desired confirmatory surveys.

Phase 1 Final Status Surveys of Equalization Tank Excavation

Even though the equalization tank was not known to be impacted by radioactivity in mid-2008, as indicated in Section 7, Phase 1 final status surveys would be performed in the excavation made to remove the tank as a good practice. These surveys would be performed as specified in Phase 1 Final Status Survey Plan and would typically include measurements with a sensitive gamma detector.

After surveys specified in the Phase 1 Final Status Survey Plan are completed, the area would be made available to NRC or its contractor for any desired confirmatory surveys.

9.7.6 WMA 7 NDA and Associated Facilities

No additional characterization would be performed in the NDA itself. Table 4-10 summarizes the estimated NDA radionuclide inventory. In WMA 7, only removal of concrete and gravel pads associated with the NDA Hardstand are within the scope of this plan.

WMA 7 Facility Characterization Surveys

Characterization measurements of the hardstand would be performed in connection with proposed decommissioning activities.

Description of Planned Survey Measurements. Measurements would typically include exposure rates and material samples analyzed for radionuclides of interest.

Justification for Planned Survey Measurements. These are the appropriate measurements necessary to facilitate radiation protection and support proposed decommissioning activities and waste management.

WMA 7 In-Process Surveys

In-process surveys would be performed during remediation as specified in Section 9.5.

WMA 7 Phase 1 Final Status Surveys

Surveys of the resulting exposed excavation surfaces would be performed in accordance with the Phase 1 Final Status Survey Plan.

WMA 7 Confirmatory Surveys

Arrangements would be made for any confirmatory surveys desired by NRC or its contractor before the excavation is filled in.

9.7.7 WMA 8, State Licensed Disposal Area

There are no facilities within WMA 8 that are within plan scope.

9.7.8 WMA 9, Radwaste Treatment System Drum Cell Area

Phase 1 proposed decommissioning activities in WMA 9 include total removal of the building, floor slabs and foundations of the Radwaste Treatment System Drum Cell, the NDA trench soil container area, and the subcontractor maintenance area.

Characterization of the Radwaste Treatment System Drum Cell Area

Characterization measurements would be performed in this building commensurate with plans for its disposition, which is removal. Characterization measurements would also be taken in the trench soil container area and the subcontractor maintenance area.

Description of Planned Survey Measurements. Measurements would typically include exposure rates, removable contamination, and total contamination.

Justification for Planned Survey Measurements. These are the appropriate measurements necessary to facilitate radiation protection and support proposed decommissioning activities and waste management.

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In-Process Surveys Related to the Radwaste Treatment System Drum Cell

In-process surveys would be performed during removal activities as specified in Section 9.5.

Phase 1 Final Status Surveys of the Radwaste Treatment System Drum Cell

Following building demolition and removal of the floor slab and foundation, Phase 1 final status surveys on the exposed excavation surface would be performed in accordance with the Phase 1 Final Status Survey Plan.

Confirmatory Surveys of the Radwaste Treatment System Drum Cell Excavation

After Phase 1 final status surveys are completed, arrangements would be made to have any desired confirmatory surveys accomplished.

The NDA Trench Soil Container Area and the Subcontractor Maintenance Area

Characterization measurements would be performed in these areas commensurate with plans for their disposition, which is removal.

Description of Planned Survey Measurements. Measurements would typically include exposure rates and soil samples analyzed for radionuclides of interest.

Justification for Planned Survey Measurements. These are the appropriate measurements necessary to facilitate radiation protection and support proposed decommissioning activities and waste management.

Other surveys of this area would include in-process surveys in accordance with Section 9.5, Phase 1 final status survey of the excavations in accordance with the Phase 1 Final Status Survey Plan, and any confirmatory surveys desired by the regulators.

9.7.9 WMA 10, Support and Services Area

Neither of the facilities within WMA 10 within plan scope, the New Warehouse and the former Waste Management Storage Area, nor the remaining concrete floor slabs and foundations to be removed, had been impacted by radioactivity as of mid-2008.

WMA 10 Facility Characterization Surveys

Characterization measurements would be performed in these facilities, floor slabs, and foundations in connection with proposed decommissioning activities.

Description of Planned Survey Measurements. Measurements would typically include exposure rates, removable contamination, and total contamination.

Justification for Planned Survey Measurements. These are the appropriate measurements necessary to facilitate radiation protection and support decommissioning activities and waste management.

WMA 10 Facility In-Process Surveys

In-process surveys would be performed during remediation as specified in Section 9.5.

WMA 10 Facility Phase 1 Final Status Surveys

Phase 1 final status surveys on the exposed excavation surfaces would be performed in accordance with the Phase 1 Final Status Survey Plan.

Limited Phase 1 final status surveys would be performed in the Security Gatehouse as a good practice because of the proximity of this facility to the Process Building. These surveys would be judgmental in scope and include scan surveys with a sensitive gamma detector such as a Bicon Micro Rem instrument.

Confirmatory Surveys of WMA 10 Facilities

Arrangements would be made for any confirmatory surveys desired by NRC or its contractor.

9.7.10 WMA 11, Bulk Storage Warehouse and Hydrofracture Test Well Area

No facilities in WMA 11 are within plan scope. Neither characterization nor Phase 1 final status surveys are planned in this area.

9.7.11 WMA 12, Balance of the Site

No facilities in WMA 12 are within plan scope. Neither characterization nor Phase 1 final status surveys are planned in this area.

9.7.12 Environmental Media

Environmental media to be considered includes soil, sediment, groundwater, and surface water on the project premises.

Existing Characterization Data

Description of Previous Survey Measurements. As explained in Section 4.2, existing data on radioactivity in environmental media comes from three principal sources: (1) the site environmental monitoring program, (2) a series of RCRA facility investigations completed in the mid-1990s, and (3) Geoprobe® investigations of the north plateau groundwater plume. Data are also available on surface radiation levels that are indicative of soil contamination in some areas from 1984 and earlier aerial surveys and a 1990 overland survey that measured gamma radiation levels.

As explained in Section 4.2, data on radioactivity in environmental media were obtained using methods such as laboratory analysis of soil and groundwater samples and measuring exposure rates using sensitive gamma detectors.

Justification for Previous Survey Measurements. The measurements were made for several purposes, including regular monitoring of the environment and specific investigations related to hazardous materials and the north plateau groundwater plume.

Soil and Sediment Characterization Surveys

Surface soil, subsurface soil, and sediments in the Phase 1 areas would be surveyed and sampled for laboratory analysis. Subsurface soil in the non-source area of the plume, in the plume impacted areas, and Phase 2 areas would not be addressed at this time.

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Description of Survey Measurements. The process to be utilized would include:

- Consideration of available characterization data;
- The use of marked grids, such as 100 feet by 100 feet, in areas where systematic measurements are made;
- Surface scans for gamma activity in areas likely to contain residual contamination;
- Surface soil samples;
- Subsurface soil samples where indicated by contamination potential, including locations of subsurface features such as tanks and process lines;
- Additional subsurface samples in the top portion of the Lavery till in the WMA 1 and WMA 2 excavation footprints as specified in Section 7.2.2; and
- Sediment samples where indicated by contamination potential, including sediment in Erdman Brook and the portion of Franks Creek within the project premises security fence.

Special attention would be paid to the lagoons, basins, and discharge ponds, including the area of Lagoon 1 where previously buried radioactive debris would be removed. The experience of other DOE sites such as Mound, Fernald, and Ashtabula that have extensive experience with contaminated soil characterization would be considered. Details would appear in the Characterization Sample and Analysis Plan.

Justification for Survey Measurements. These measurements would provide information on soil and sediment contamination to support decontamination activities, facilitate radiation protection, and waste disposal plans.

Phase 1 Final Status Surveys of Soil Areas and Areas Containing Sediment

Description of Survey Measurements. Phase 1 final status surveys would be performed as specified in the Phase 1 Final Status Survey Plan in the excavation made to remove the Equalization Basin and the two demineralizer sludge ponds. Remediation of surface soil and streambed sediment may also be accomplished in Phase 1, as explained in Section 7. If this is done, Phase 1 final status surveys of the remediated areas would be performed. The process to be utilized would be similar to that for characterization surveys, with details included in the Phase 1 Final Status Survey Plan. The same grids would be reestablished and used where practicable. Characterization data would be considered in the survey design and used for Phase 1 final status survey purposes where practicable.

Justification for Survey Measurements. These measurements would provide information on soil and sediment contamination to demonstrate that release criteria are achieved as applicable.

Confirmatory Surveys of Soil Areas and Areas Containing Sediment

Arrangements would be made for confirmatory surveys by NRC or its contractor after the Phase 1 final status surveys are completed.

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Groundwater

Radioactivity in groundwater would continue to be monitored during Phase 1 of the proposed decommissioning by laboratory analysis of samples drawn from the network of monitoring wells. Appendix D addresses monitoring of groundwater following the completion of Phase 1 proposed decommissioning activities. No separate characterization or Phase 1 final status surveys would be performed for groundwater.

Surface Water/Stream Sediment

Radioactivity in surface water and associated stream sediment would continue to be monitored during the decommissioning in connection with the environmental monitoring and control program outlined in Section 1.8 and Appendix D. No separate characterization or Phase 1 final status surveys would be performed.

9.8 Phase 1 Final Status Survey Report Requirements

The requirements for Phase 1 Final Status Survey Report would be identified in the Phase 1 Final Status Survey Plan. As indicated previously, because of the site complexity there may be multiple Phase 1 Final Status Survey Plans. Consequently there may be multiple Phase 1 Final Status Survey Reports. The content and coverage of the plans and reports would be determined using the DQO Process in the project planning cycle. These report requirements would include the following.

9.8.1 Overview of Results

The report would summarize the results of the surveys.

9.8.2 Discussion of Changes

The report would include a discussion of any changes that were made in the Phase 1 final status survey from what was proposed in this plan or other prior submittals.

9.8.3 Description of How Numbers of Samples Were Determined

The report would include a description of the method by which the number of samples was determined for each survey unit.

9.8.4 Sample Number Determination Values

The report would include a summary of the values of site parameters and data statistics used to determine the number of samples and a justification for these values.

9.8.5 Results for each Survey Unit

The report would include the survey results for each survey unit, including:

- The number of samples taken for the survey unit;
- A map or drawing of the survey unit showing the reference system and random start systematic sample locations for Class 1 and 2 survey units and random locations shown for Class 3 survey units and reference areas;
- The measured sample concentrations;

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- The statistical evaluation of the measured concentrations;
- Judgmental and miscellaneous sample data sets reported separately from those samples collected for performing the statistical evaluation;
- A discussion of anomalous data, including any areas of elevated direct radiation detected during scanning that exceeded the investigation level or measurement locations in excess of $DCGL_W$ and any actions taken to reduce them, if any, upon detection⁵; and
- A statement that a given survey unit satisfied the $DCGL_W$ and the elevated measurement comparison if any sample points exceeded the $DCGL_W$.

9.8.6 Survey Unit Changes

The report would include a description of any changes in initial survey unit assumptions relative to the extent of residual radioactivity.

9.8.7 Actions Taken for Failed Survey Units

If a survey unit fails, a description of the investigation conducted to ascertain the reason for the failure and a discussion of the impact that the failure has on the conclusion that the facility is ready for Phase 1 final radiological surveys would be included in the report.

9.8.8 Impact of Survey Unit Failures

For any survey units that fail, the report would include a discussion of the impact that the reason for the failure has on other survey unit information.

9.9 References

DOE Orders, Policies, Manuals, and Standards

DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, Change 2. U.S. Department of Energy, Washington, D.C., January 7, 1993.

Other References

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⁵ This would include application of the as low as reasonably achievable (ALARA) principal as discussed in Section 6.

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